Appendix D

Supplemental Information on the Low Level Burial Grounds, Environmental Restoration Disposal Facility, Borrow Pits, Trench Liners, and Disposal Facility Barriers

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Supplemental Information on the Low Level Burial Grounds, Environmental Restoration Disposal Facility, Borrow Pits, Trench Liners, and Disposal Facility Barriers

This appendix contains information on the Low Level Burial Grounds (LLBGs), the Environmental Restoration Disposal Facility (ERDF), the borrow pits used for the closure covers of the LLBGs, liners used in disposal facilities, and barriers that will be placed over the disposal facilities after they are filled.

D.1 Low Level Burial Grounds

The LLBGs are eight separate waste disposal areas located in the 200 Areas. They are regulated under the Atomic Energy Act (AEA) of 1954 (42 USC 2011) and the trenches that contain MLLW are also regulated under Resource Conservation and Recovery Act (RCRA) (42 USC 6901; 40 CFR 261.8), and applicable state laws and regulations (WAC 173-303). The following sections summarize specific information concerning the LLBGs.

D.1.1 200 East Area Burial Grounds

Burial Ground 218-E-12B. Burial Ground 218-E-12B (Figure D.1) is located in the northeast corner of the 200 East Area. It covers approximately 70.1 ha (173.2 ac) and began receiving waste in 1962. Burial Ground 218-E-12B has three trenches containing retrievably stored transuranic (TRU) waste, but contains primarily low-level waste (LLW) generated by facilities in the 200 East Area. Trench 94, a portion of 12B, is reserved for the disposal of U.S. Navy defueled reactor compartments composed of various types of steel and lead shielding.

The reactor compartments contain polychlorinated biphenyls (PCBs) bulk product waste and may be disposed of under 40 CFR 761 as non-hazardous radioactive waste. However, the trench is regulated under the Washington State Dangerous Waste regulations for lead and is permitted for the disposal of mixed low-level waste.

Burial Ground 218-E-10. Burial Ground 218-E-10 (Figure D.2) is located in the northwest corner of the 200 East Area and is used primarily for LLW disposal, although it also contains MLLW. It began receiving waste in 1960 and covers approximately 36.1 ha (89.2 ac). Waste in this burial ground came from the 200 East and 100 N Areas facilities, and was primarily received in large concrete boxes.

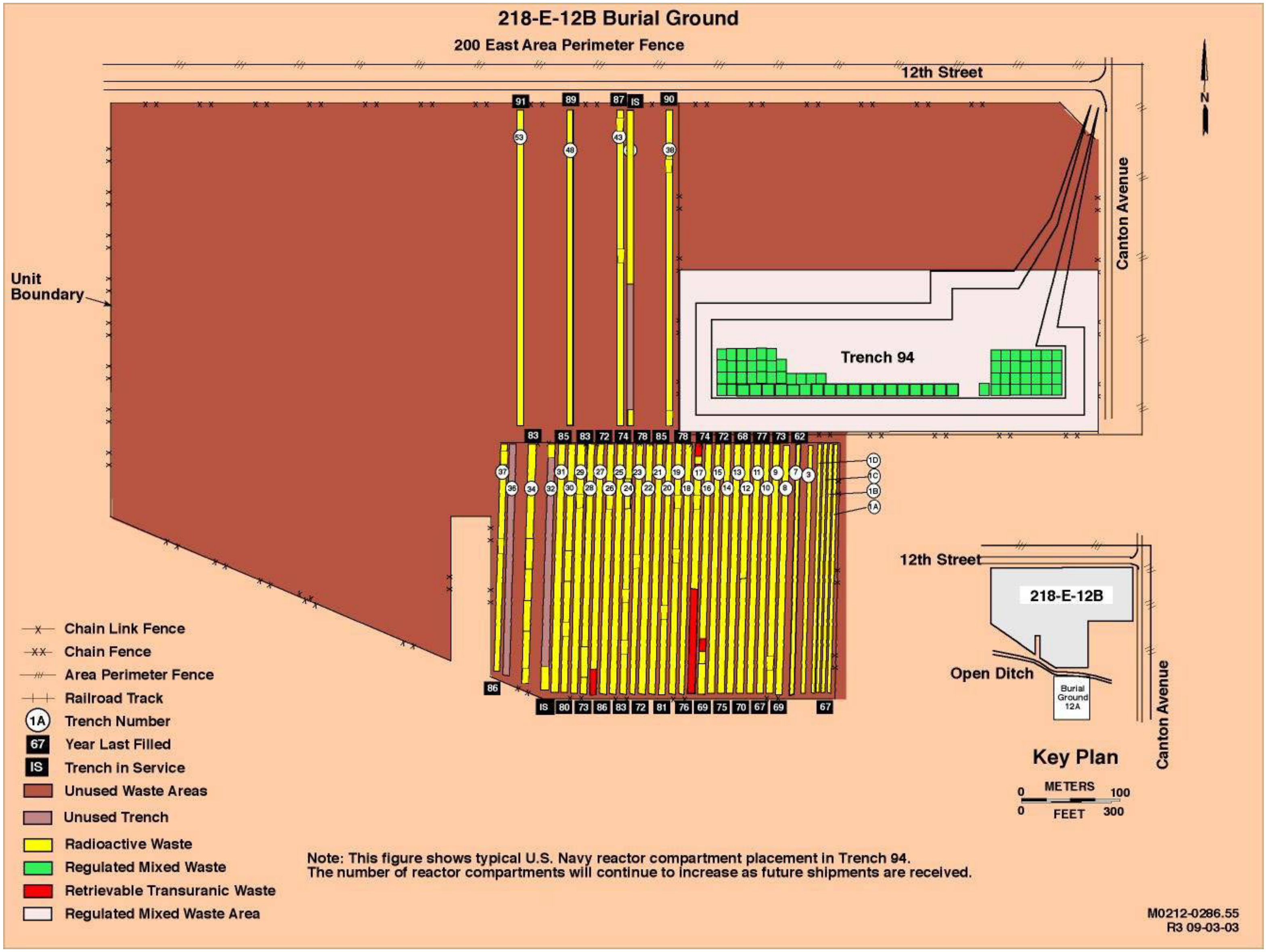

Figure D.1. 218-E-12B Burial Ground

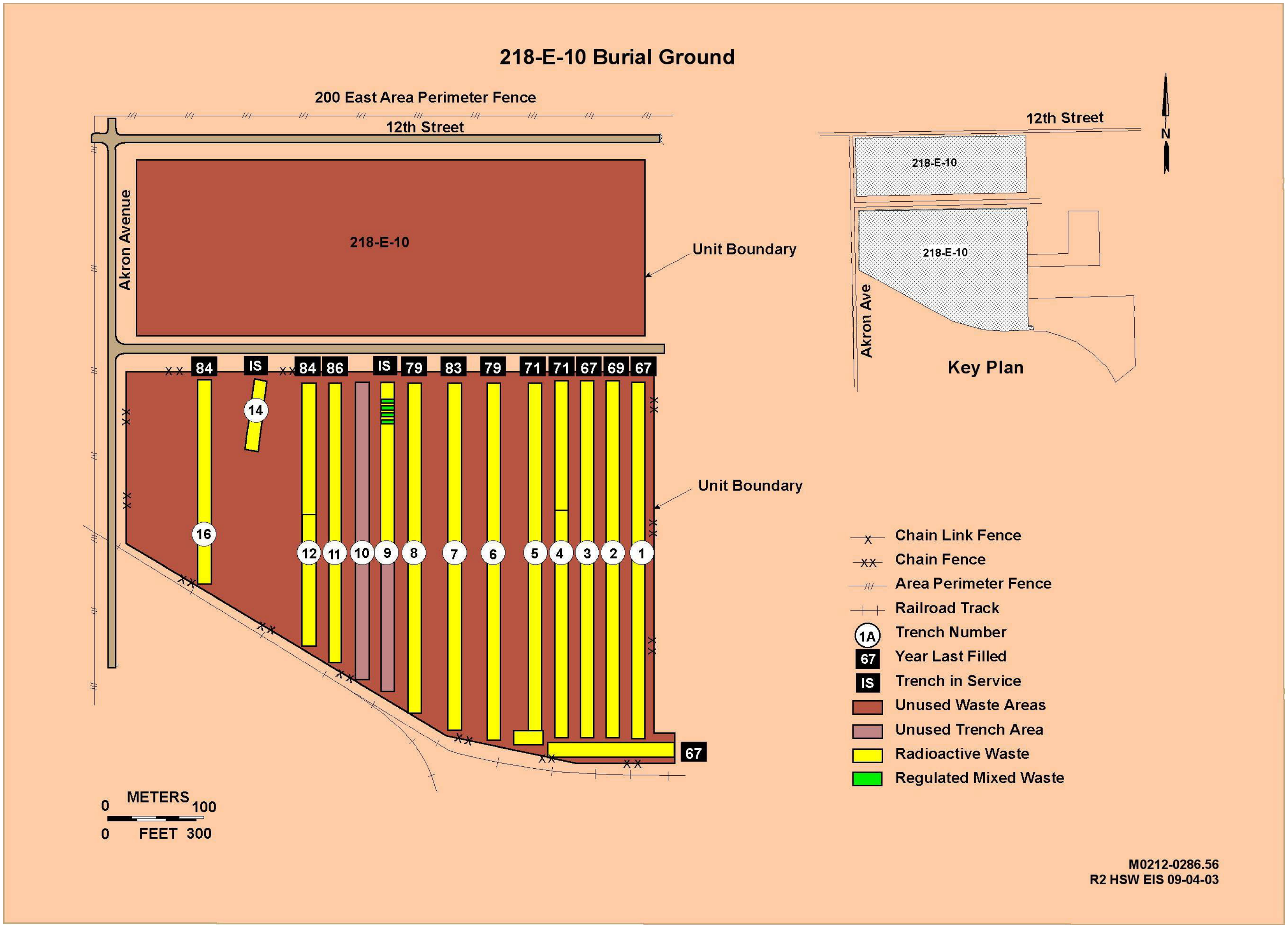

Figure D.2. 218-E-10 Burial Ground

D.1.2 200 West Area Burial Grounds

Burial Ground 218-W-3A. Burial Ground 218-W-3A (Figure D.3) began receiving waste in 1970. Located in the north-central section of 200 West Area, it covers approximately 20.4 ha (50.3 ac). Primarily, it receives LLW, but also contains MLLW, and retrievably stored TRU waste.

Burial Ground 218-W-3AE. Burial Ground 218-W-3AE (Figure D.4) covers approximately 20 ha (49.4 ac) and began receiving waste in 1981. It contains primarily LLW, although MLLW is present. This burial ground includes Trenches 05 and 10 that are wide-bottom stacking trenches, and Trench 26 that was dug with a wide bottom to dispose of LLW railroad cars and large tanks.

Burial Ground 218-W-4B. Burial Ground 218-W-4B (Figure D.5) began receiving wastes in 1968, and is located in the central portion of the 200 West Area. It consists of 14 trenches (one containing 12 caissons, of which 4 caissons contain TRU waste) and covers 3.5 ha (8.6 ac). The trenches in this burial ground contain unsegregated TRU waste and contact-handled (CH) TRU waste stored on an asphalt pad mostly in 55-gal drums. Trench 7 contains one of the earlier designs for retrievably stored TRU waste—the V trench. The concrete V trench stores waste containers on a 45-degree angle and is covered with a metal roof and soil. The TRU waste in Trench 11 contains either remote-handled (RH) or CH wastes. Trench 14 contains caissons that are underground storage structures for the disposal of 3.8-L (1-gal) to 18.9-L (5-gal) cans of RH waste.

Five caissons were planned for TRU waste and from 1970 to 1988 retrievably stored TRU waste was placed in four of them. The caissons have been isolated. One caisson has never been used. Seven caissons containing LLW were filled from 1968 to 1979 and are also found in this burial ground. No additional waste placement is planned for any of these caissons. All the trenches in this burial ground are covered with earth.

Burial Ground 218-W-4C. Burial Ground 218-W-4C (Figure D.6) started receiving waste in 1978. It covers approximately 20 ha (49.4 ac) and mainly receives LLW, although some MLLW and retrievably stored TRU wastes are also present. The most northern trench (Trench NC) contains core barrels from naval bases. Trench 1 contains mostly retrievably stored TRU waste, including drums generated from mining the 216-Z-9 Crib. Trench 4 also contains retrievably stored TRU waste. Trench 7 contains retrievably stored TRU boxes and drums of Test Reactor and Isotope Production General Atomics (TRIGA) fuel waste. Additional retrievably stored TRU wastes in boxes and drums are located in Trenches 19, 20, 24, and 29.

Burial Ground 218-W-5. The 218-W-5 Burial Ground (Figure D.7) began receiving wastes in 1986. It covers approximately 37.2 ha (91.9 ac) (excluding the expansion area) and accepts MLLW and LLW. The 218-W-5 Burial Ground currently contains two permitted MLLW trenches.

Burial Ground 218-W-6. Burial Ground 218-W-6 (Figure D.8) covers approximately 16 ha (39.5 ac). To date, it has not received any waste.

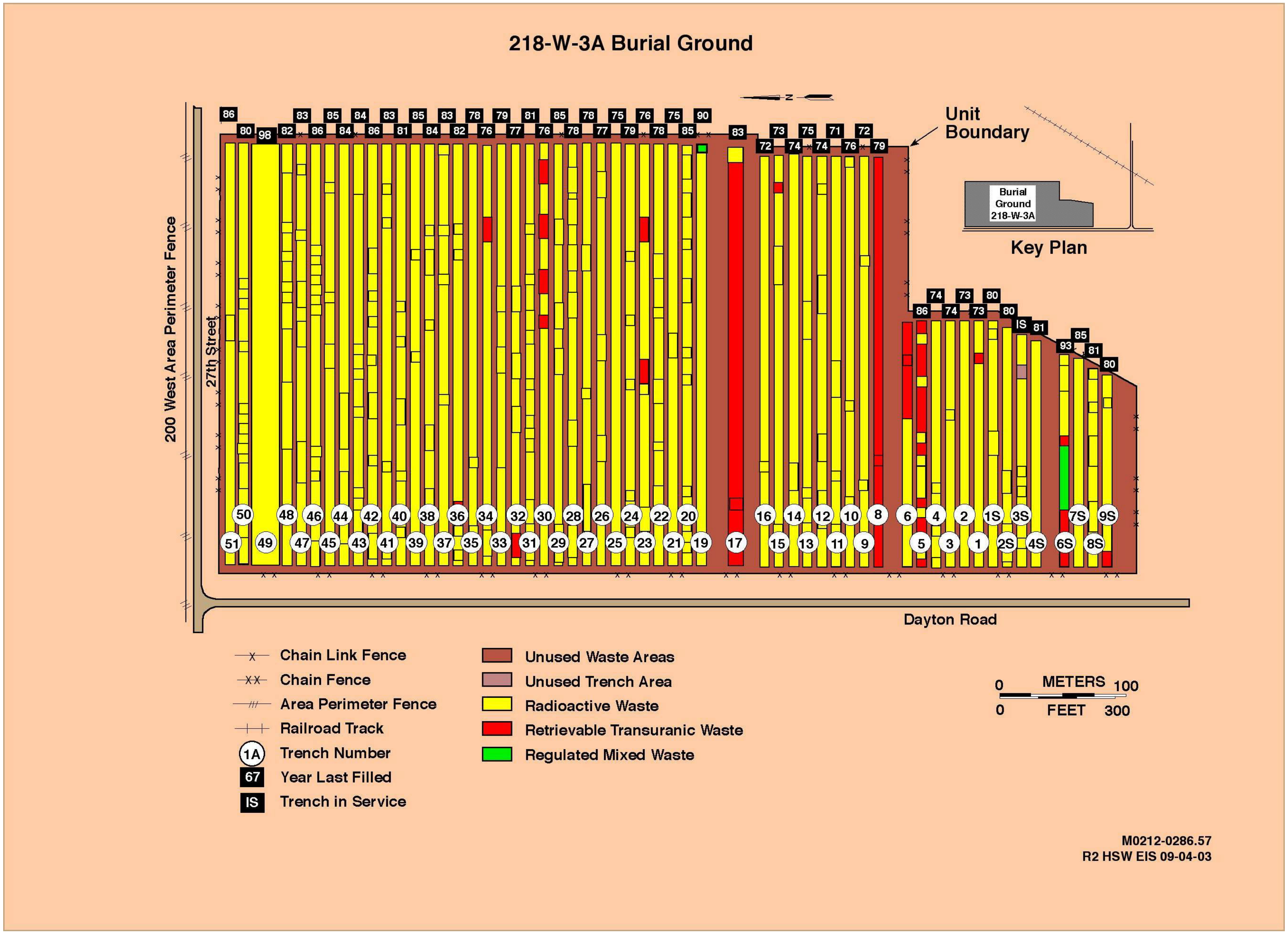

Figure D.3. 218-W-3A Burial Ground

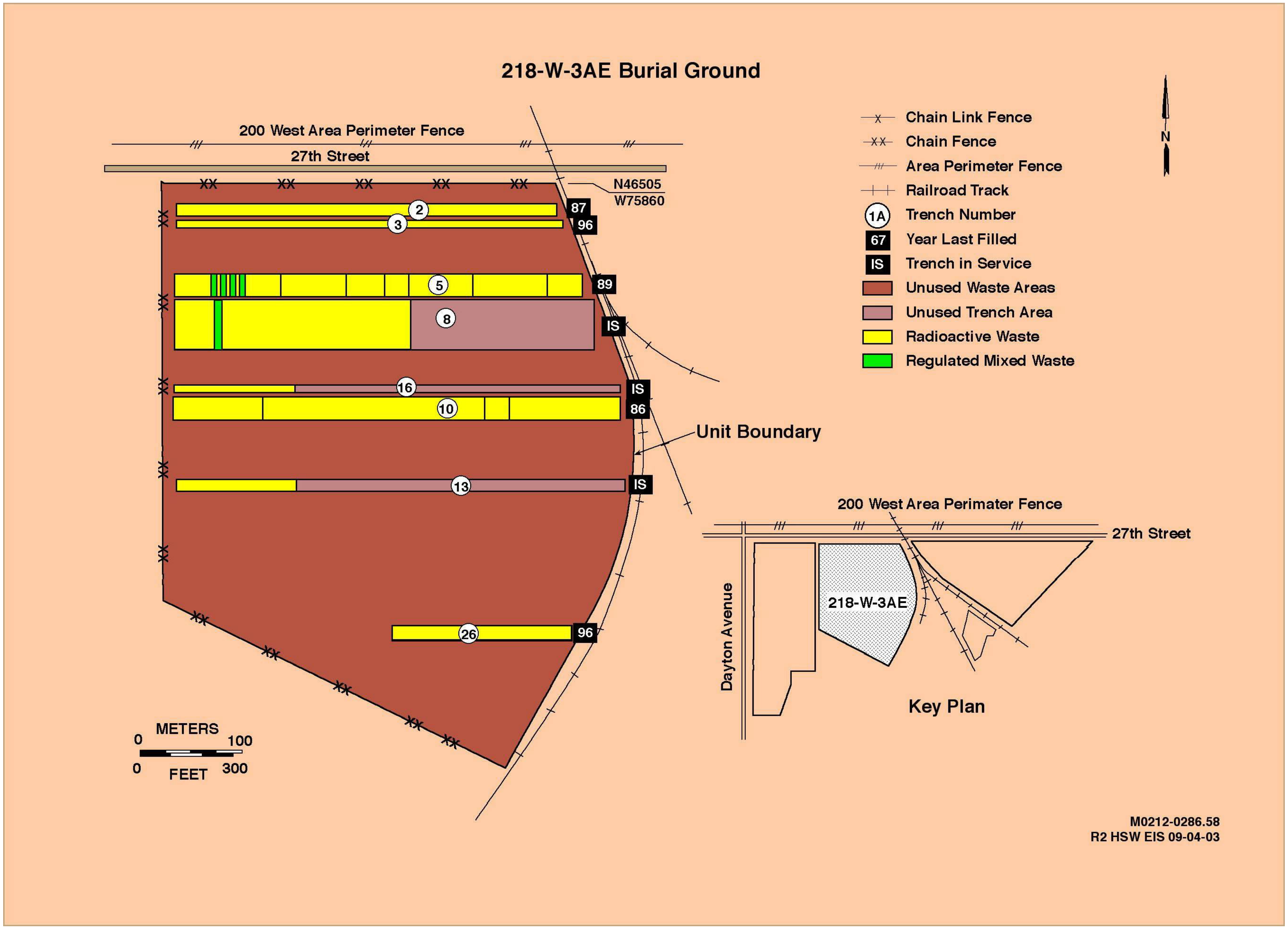

Figure D.4. 218-W-3AE Burial Ground

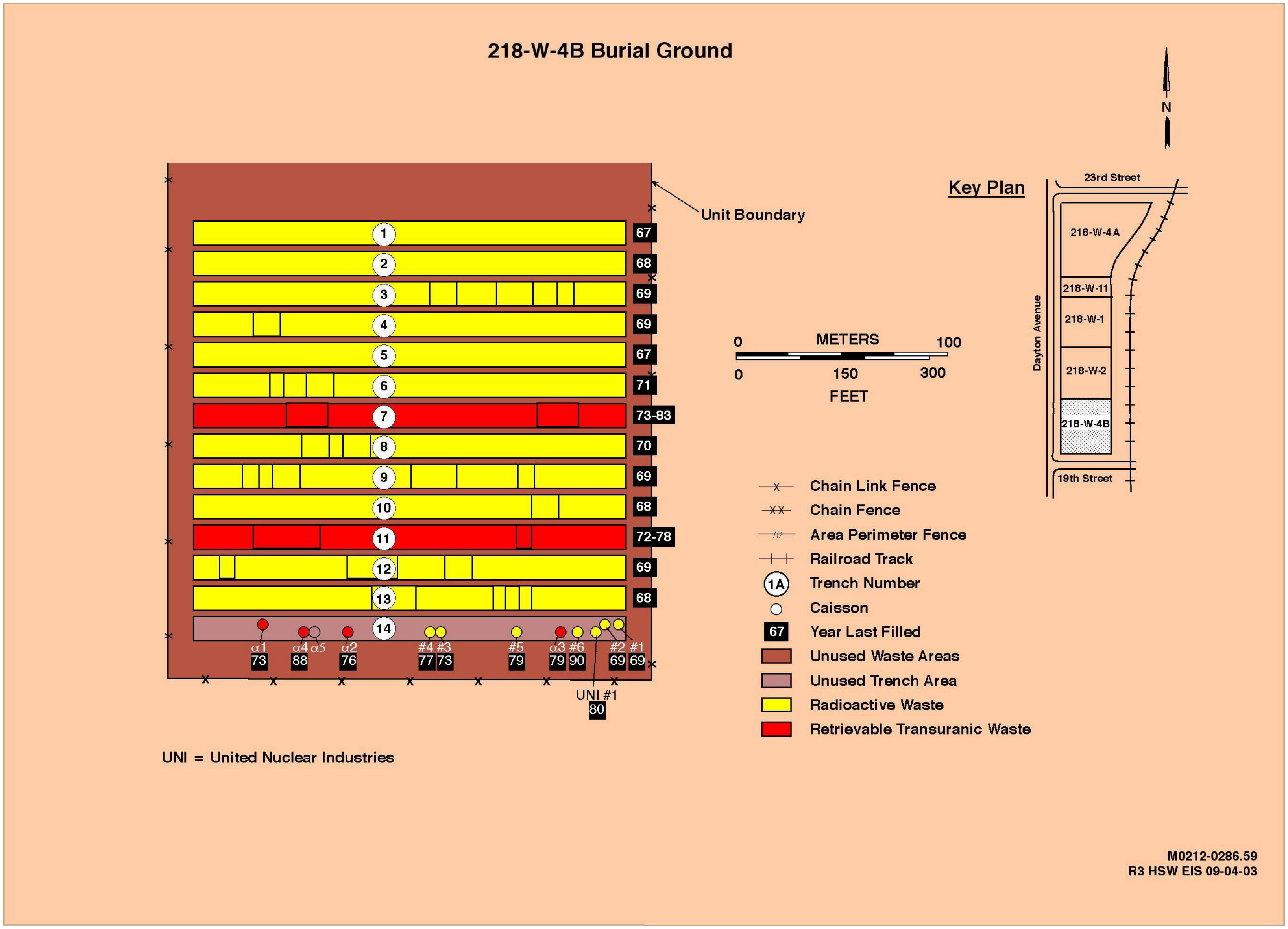

Figure D.5. 218-W-4B Burial Ground

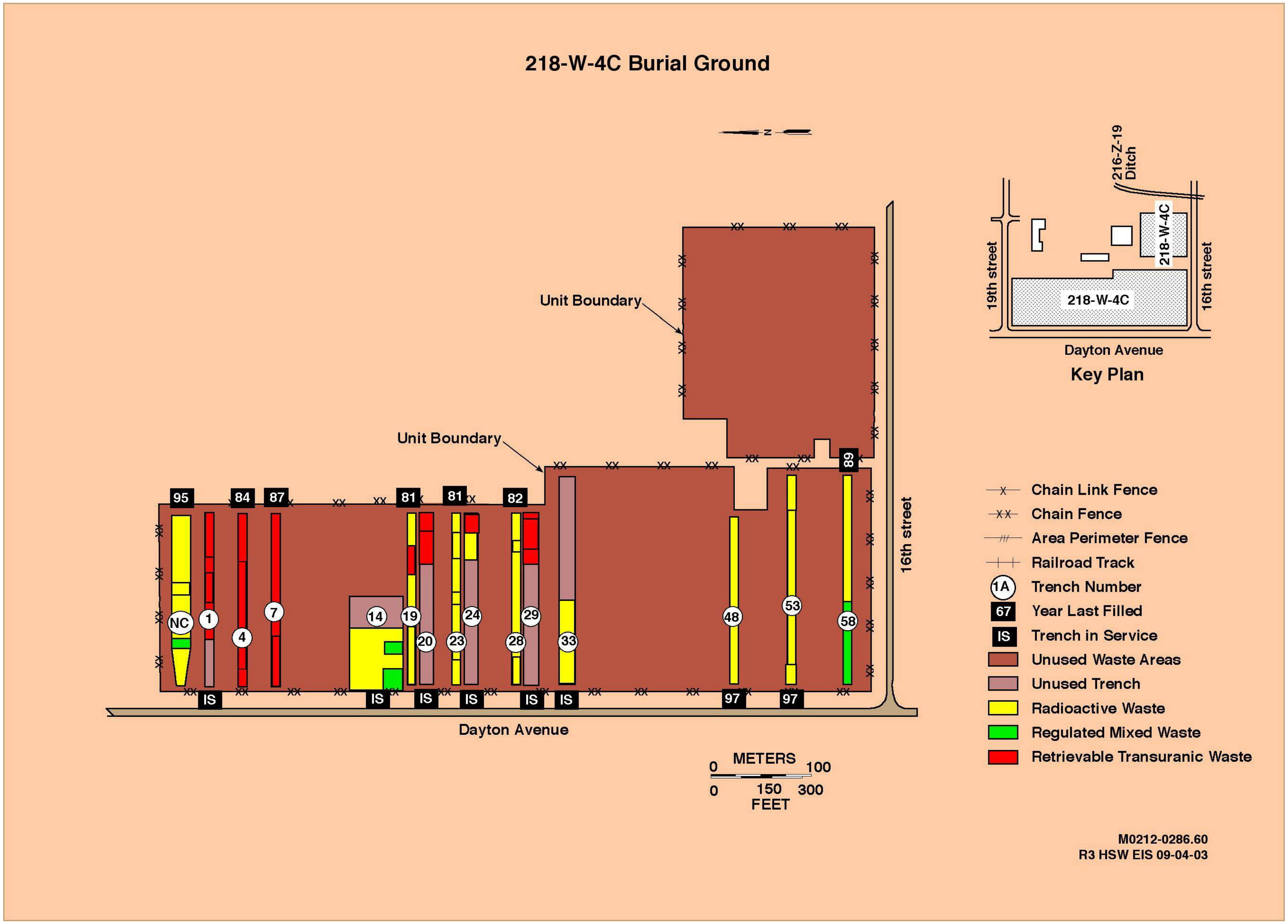

Figure D.6. 218-W-4C Burial Ground

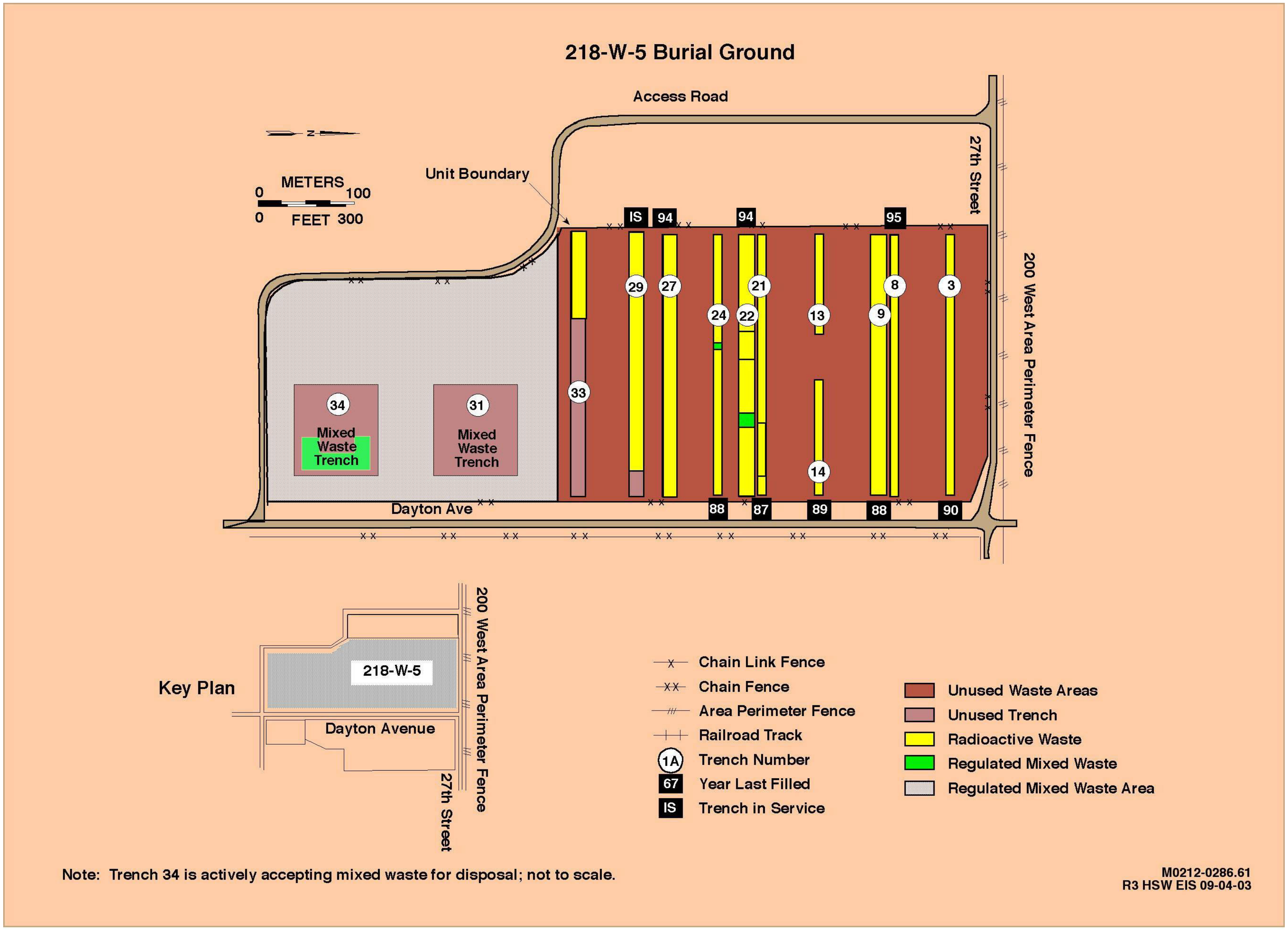

Figure D.7. 218-W-5 Burial Ground

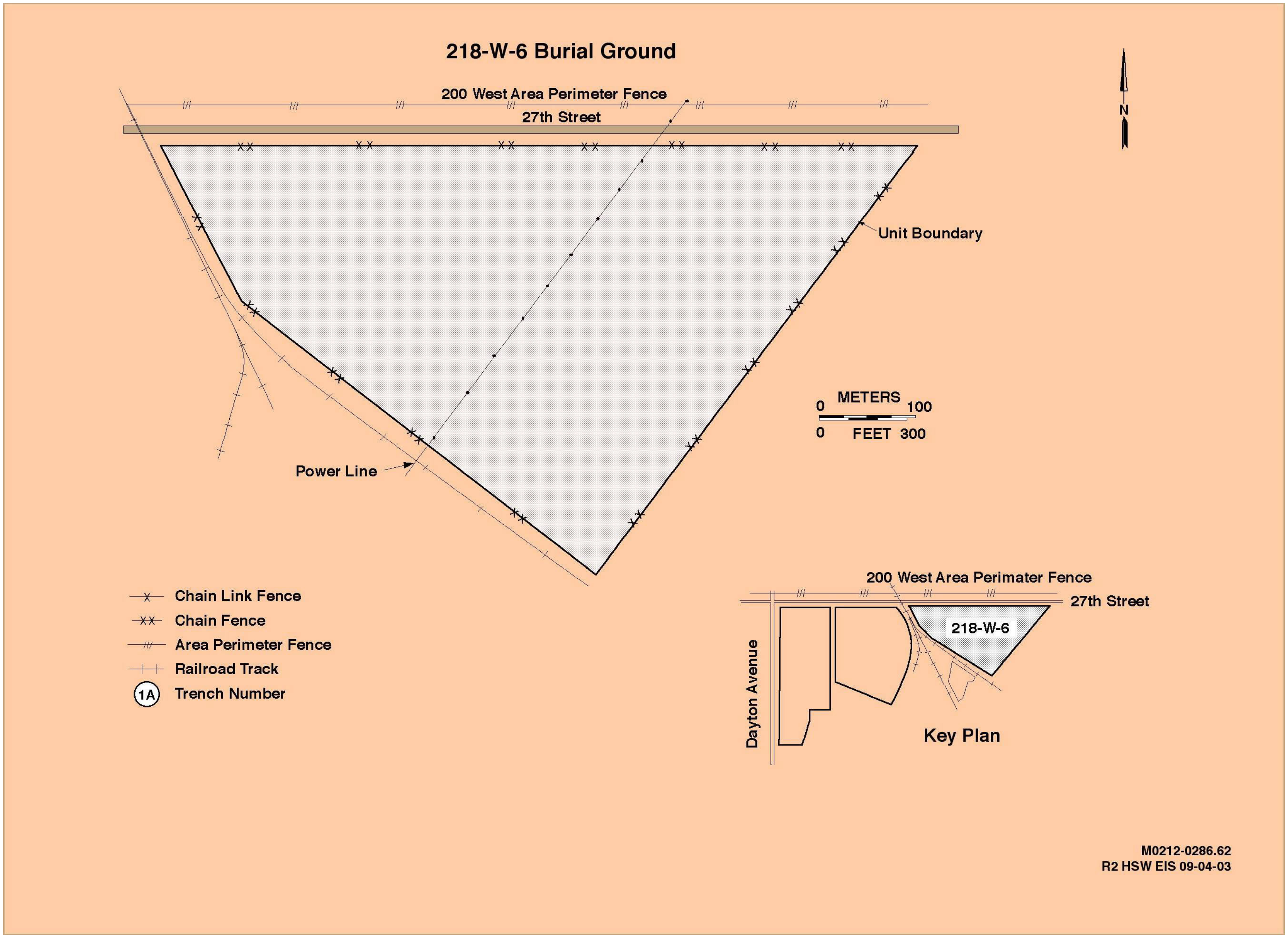

Figure D.8. 218-W-6 Burial Ground

D.2 Environmental Restoration Disposal Facility

ERDF is Hanford's low-level and hazardous waste disposal facility for wastes from CERCLA cleanup activities. It is located on the Central Plateau, as can be noted in Figure 3.2 in Section 3. The facility is composed of a number of cells, as illustrated in Figure D.9. The first two cells were completed in 1996 and are 21 m (70 ft) deep, 152 m (500 ft) long and 152 m (500 ft) wide. Construction of cells 3 and 4 began in 1998 and were ready to begin receiving waste in the spring of 2000. Together, the four cells have a capacity of 4.7 billion kg (5.2 million tons). It is expected that the capacity will be filled in March of 2005 with the current operations. DOE is planning on adding four more cells to ERDF to double its capacity. It is currently planned to have those cells constructed and ready to receive waste in 2005.

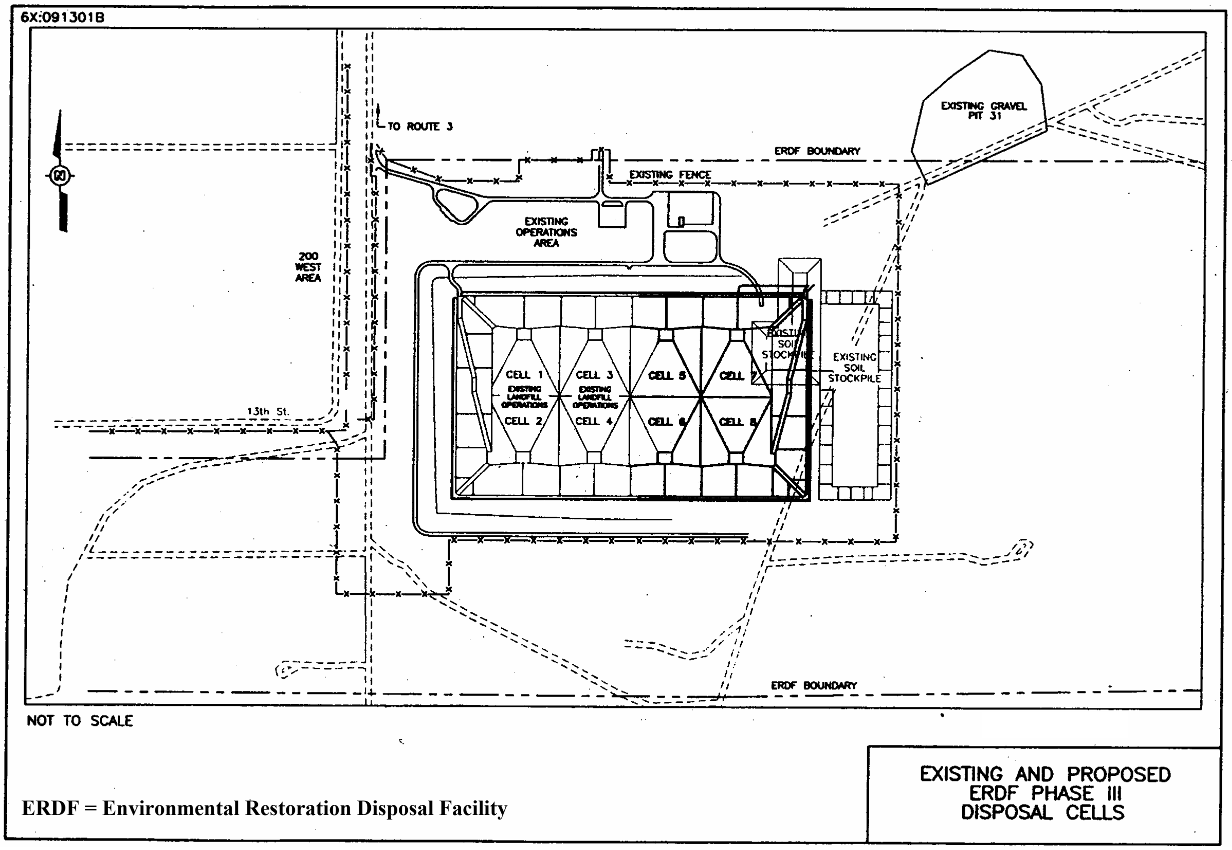

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Figure D.9. Existing and Proposed ERDF Disposal Cells

D.3 Borrow Pit Resource Excavation

Up to approximately 3,700,000 m^3 (approximately 5,000,000 yd^3) of sand, gravel, rock, and silt/loam will be required as a mineral resource for up to 178 ha (440 ac) of regulatory-compliant caps on LLBGs and other disposal facilities addressed in this EIS. It is anticipated that almost all of the onsite resources required for surface capping will come from Area C, shown in Figures D.10 and D.11. The only exception is materials for an asphalt layer, which would be transported from the Tri-Cities.

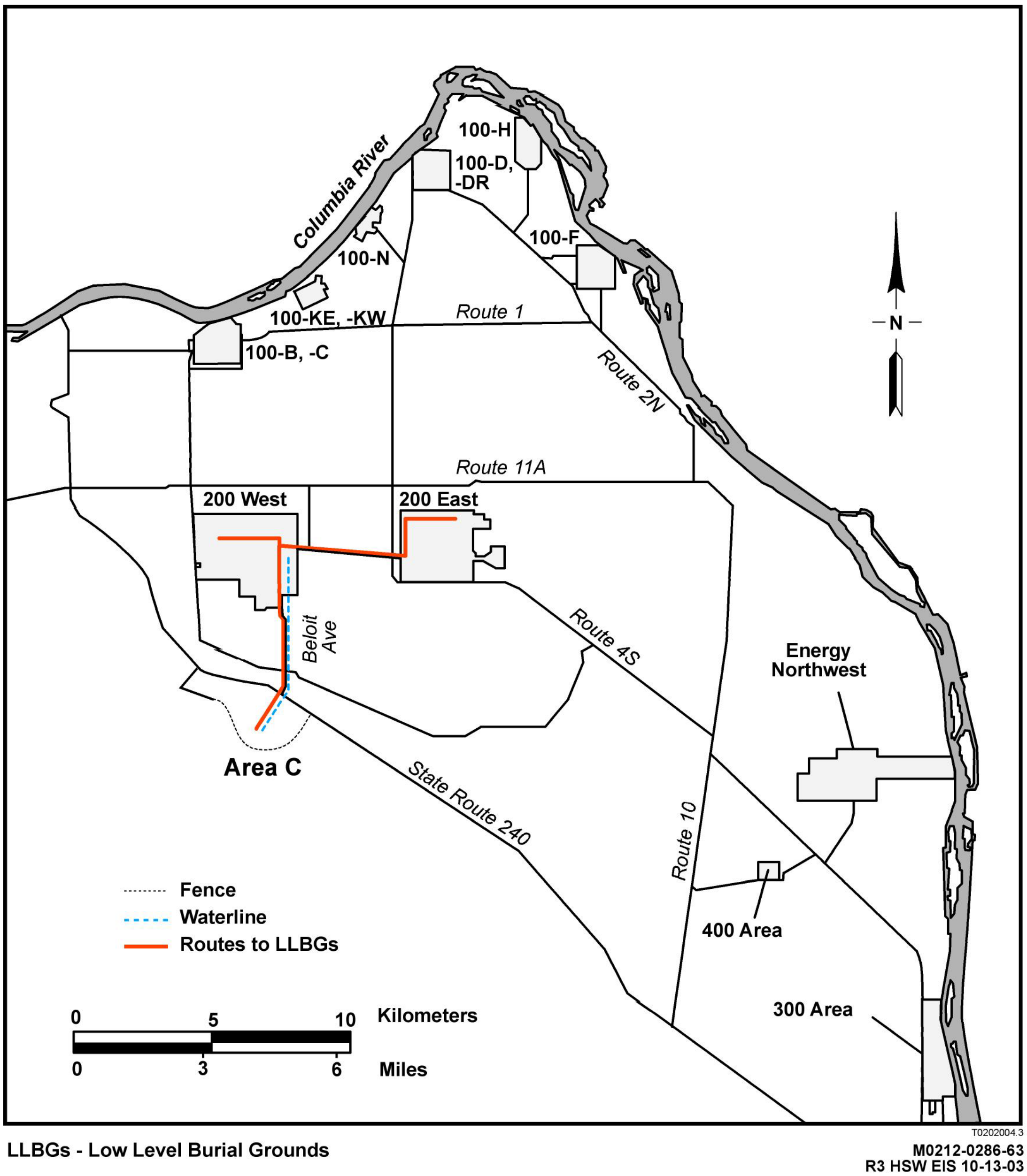

Figure D.10. Area C Location Relative to the 200 East and 200 West Burial Grounds

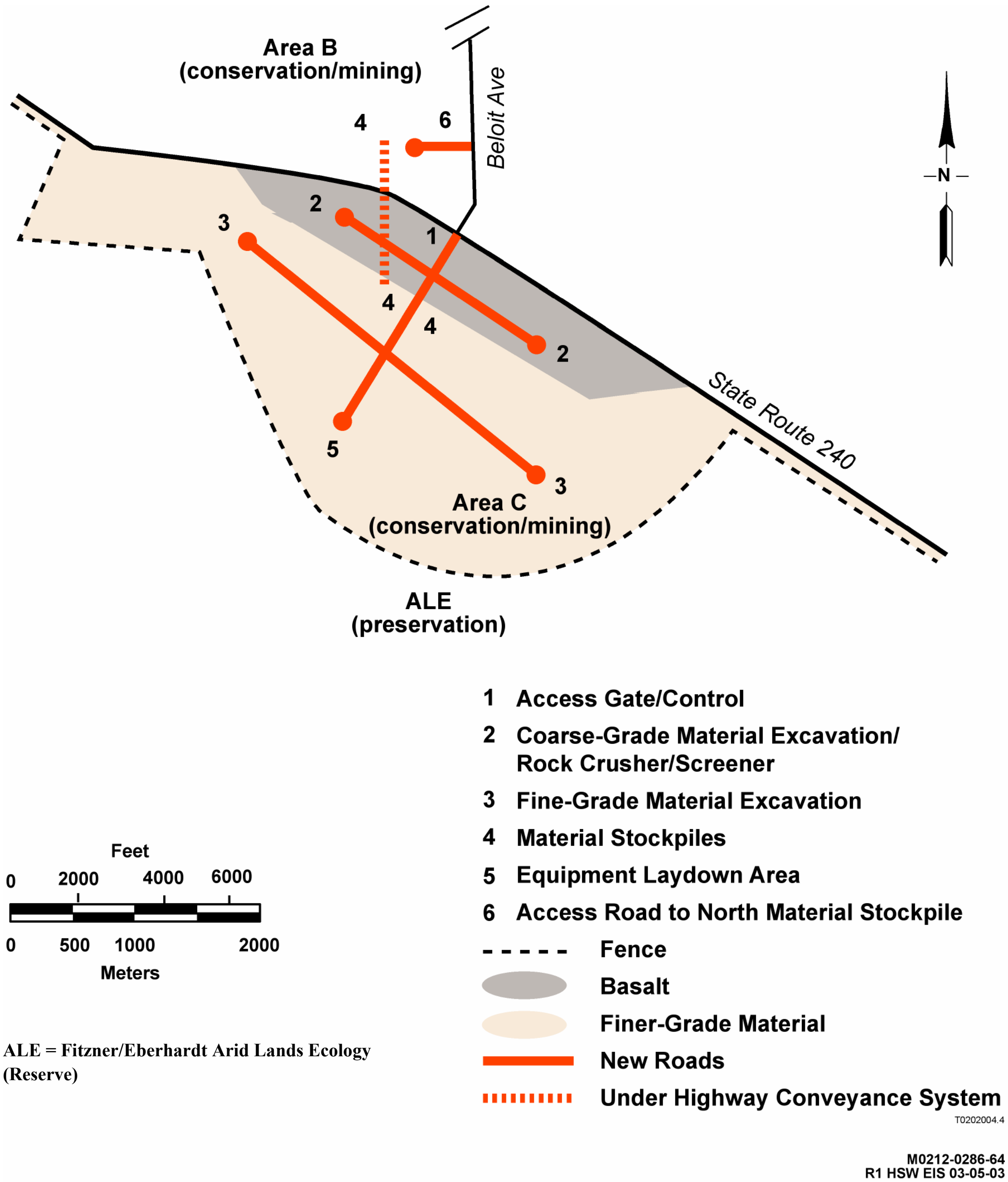

Figure D.11. Borrow Pit Layout in Area C

Although the amount of resource material varies slightly depending upon the alternative chosen, the variance is not large considering that the areas between LLW and MLLW trenches would be required to be covered to minimize contaminant migration from precipitation events. The barrier edges would be extended far enough beyond the waste trenches to preclude reintrusion of precipitation and snowmelt back into the waste zones.

Area C is on the southeast side adjacent to State Route (SR) 240 and is accessed via the Rattlesnake Gate and Beloit Avenue. Area C is a large 926-ha (2287-ac) polygonal area located adjacent to the south side of SR 240 and is centered approximately at the intersection of Beloit Avenue and SR 240. The area is bounded by SR 240 and the Fitzner/Eberhardt Arid Lands Ecology (ALE) Reserve. Area C is not part of the Hanford Reach National Monument. A small portion of the northern portion of Area C has already been used as a borrow pit. It is anticipated that less than 7.5 percent (81 ha [200 ac]) of Area C will be required for capping resource material.

Area C is considered part of the Central Plateau in the *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement* (HCP EIS) and its use is designated as "conservation (mining)" (DOE 1999). The HCP EIS acknowledges that "mining of onsite geologic materials will be needed to construct surface barriers as required by Hanford Site remediation activities."

The use of Area C as a borrow pit would have the following restrictions required by the Hanford Site procedures and best management practices:

1. A restoration plan would be written to direct how the site would be revegetated and restored.

2. Topsoil would be stripped and stockpiled for use in revegetation.

3. Excavation and bank cuts would be kept a minimum of 152 m (500 ft) from SR 240.

4. Areas prone to wind erosion (for example, active pit faces, haul roads, stockpiles) would be stabilized as needed with ballast or other means, such as routine wetting with water and a stabilization agent.

5. Approximately 8 km (5 mi) of new roads within Area C (see Figure D.10) would be built to expedite traffic and shorten haul roads. It is anticipated that the access road would intersect SR 240 directly across from the intersection of the highway from Beloit Avenue.

6. Immediately following the removal of material from each pit, cut banks would be sloped and the sides of the pits would be shaped with irregular boundaries to avoid straight lines and to more naturally blend with the surrounding terrain.

Borrow operations at Area C would consist of the following:

- **Infrastructure Upgrade –** Water and electricity would be extended from the vicinity of Beloit Avenue and 13th Street, a distance of 6.4 km (4 mi). New gravel roads would be installed within Area C to access the mineral resource, laydown areas, office areas, and resource stockpiles. Modular space would be used for offices, lunchrooms, and showers. A holding tank would be installed to receive sanitary wastewater from trailers. Portable toilets would be provided to all other areas of the site. A contract sanitary waste hauler would service the holding tank and portable toilets at least twice weekly. Site lighting would be provided via fixed lights on poles and portable, rechargeable light stands.

- **Resource Excavation** – Borrow pits would be excavated via a track hoe, scraper, bulldozer, and/or front-end loader and loaded either directly into trucks or onto conveyor systems. Conveyor systems would be used to move the resource to stockpile areas or to load trucks. Conveyor systems would be fitted with crushing, sorting, and screening systems to segregate fines from rock. Basalt would probably be blasted with standard controlled subsurface detonations. A one-shift operation with approximately 20 trucks would require a minimum of 12 years of borrow pit operation.

- **Under Highway Conveyance System** – Part of the conveyor system discussed above would be a more permanent system installed between the access gate and road in Area C and another conservation/mining area north of SR 240 (Area B, shown in Figure D.10). Area B is also an area designated as "conservation (mining)" by the HCP EIS and would be used only as a reservoir for resource material excavated from Area C to minimize the number of truck highway crossings that could be expected during peak capping demand periods; as such, it is only expected to be in use during the latter portion of the LLBG capping mission. The same crew that performed the water and power infrastructure upgrade would be used to install a new approximately 1-m- (36-in-) diameter approximately 24-m- (80-ft-) long culvert under SR 240 (see Figure D.10), using standard horizontal boring techniques used frequently in municipal applications. A screw auger type conveyance system could then be slipped through the culvert to convey resource material from Area C to Area B.

- **Resource Restoration** – Immediately after the mineral resource from a pit is depleted, restoration activities would proceed, including laying backside slopes and eliminating straight lines to match the surrounding environment. Stockpiled topsoil would then be redistributed into the borrow pit and the area replanted with native vegetation. If necessary, water would be sprinkled onto the site to promote seed germination. It is estimated this activity would add an additional 5 percent to the cost and labor of the borrow pit operation.

- **Hauling and Stockpiling** – A fleet of haul trucks would be used to haul resource material to stockpiles (if not directly conveyed) or the LLBGs in both 200 East and 200 West Areas. The numbers of haul trucks would be similar to those associated with hauling contaminated material to the Environmental Restoration and Disposal Facility. Haul trucks would be loaded either directly from borrow pit excavations or from stockpiles. Stockpiles would be staged 152 to 305 m (500 to 1,000 ft) from SR 240 in topographically low areas to minimize wind erosion.

- **Dust and Traffic Control** – Traffic and dust control required by Area C operations are important considerations because of the vicinity of SR 240 and potential safety hazards associated with traffic. The following precautions are planned as needed:

  - Haul trucks would be fitted with roll-out tarps. If necessary, an undercarriage and wheel wash-down system would be provided near the point where the trucks cross SR 240 to minimize fugitive dusts.

  - If necessary, a traffic light could also be installed at the intersection, with warning lights on each side of it to warn oncoming traffic.

- As needed, a water truck and soil binder additive system would be employed to continuously wet site gravel roads, queues, stockpiles, and working faces (this practice has proved to be extremely effective at Hanford soil cleanup sites). A sprinkler system might also be used to control dusts.

- Excavation and truck loading activities would be discontinued when winds are excessive.

- The exposed working face of a borrow pit would be limited.

- Stockpile profiles would be minimized wherever possible.

- Haul roads and queues would be rocked.

- Conveyor systems would be fitted with misting systems to minimize fugitive dusts.

Area C was selected for use as a borrow pit because of its proximity to the 200 Area waste disposal facilities, and the borrow pit would be designed to minimize dust and safety hazards.

D.4 Liner Options for Disposal Facilities

Liners in disposal facilities can delay water entering into the vadose zone and eventually into ground water. However, liners have the potential to adversely affect long-term performance by retaining water within the disposal facility around the waste thereby leaching radioactive and hazardous components from the waste. Options for application of liners to waste disposal are described in this section.

Mixed waste disposal facilities are required by RCRA and state regulation to contain a liner underneath the waste, and LLW facilities may also use liners to retain any rain or snow water that has fallen onto the disposal facilities and contacted waste materials. This water, which is called leachate, may contain hazardous and radioactive materials that have been leached from the waste. The leachate must be contained, removed, and treated in facilities designed to meet applicable standards. These standards require that the liner function during the active operational period and for a minimum of 30 years after closure of the disposal facility. Landfill liners are typically constructed of one or more layers of earthen materials (e.g., sand, silt clay, gravel, or cobbles), plastics (e.g., high-density polyethylene [HDPE]), or a combination of these materials). The primary objective of a landfill liner is to prevent any leachate from percolating down into the underlying aquifer. The liners that have been used in the existing disposal trenches are described and illustrated in Section 2.2.3.5. Other liner options are described below:

- no liners
- regulatory-compliant liners
- clay liners
- other types of liners.

As discussed in Section 5.3, the normal soils and geologic media would retard migration of most radionuclides and chemicals. The EIS analysis assumes no liners for independent LLW disposal facilities, which has been the standard practice for the LLBGs at Hanford where the annual precipitation is low. To ensure that analyses are conservative when evaluating the potential releases from LLW disposal, even in lined facilities, no credit is taken for the liner. Due to long time period of analysis and the relative short expected life of liners (30-100 years) it was conservative to model transport to ground water as if the liner did not exist. Liners effectively minimize transport of contaminants from the disposal facility during operations. However, there is no scientific consensus regarding the lifetime of liners.

The mixed waste trenches, ERDF, and all of the lined disposal facilities evaluated in the HSW EIS alternatives are designed with liners and groundwater monitoring systems that meet applicable technical standards. The liners are a combination of clay, drainable layers, and thick polymeric liners, as discussed in Volume I, Section 2.2.3.5.

Some disposal facilities use only a clay liner with its natural ability to retard water flows. Smectite or bentonite-type clays are suitable for this function because they have very low permeability to water and are less subject to geologic modification with time than polymeric liners. However, they can be subject to shrinkage and cracking as the water environment changes.

Another option for minimizing contaminant migration could be the use of a permeable reactive barrier in-lieu of the traditional double-lined system. Disposal facility trench design could optimize the physical and chemical characteristics in a trench bottom in order to maximize artificially created attenuation of radionuclides and hazardous waste components. Disposal site design could optimize the soil adsorption capacity by artificially creating a permeable reactive barrier in the trench bottom by adding such materials as flyash, zeolite clays, various oxides, zero valence metals (e.g., metallic iron), granulated activated carbon, phosphates, lime, and peat. Manipulating trench-bottom material pH could also assist in enhancing specific contaminants' retardation. The type and amount of additives, method of additive installation (e.g., layered adsorbents vs. a homogenous blend of adsorbents), and physical/ chemical manipulations deployed to create an artificial reactive barrier would depend primarily on such factors as waste composition (types and volumes) and climate. Preliminary field and laboratory tests have demonstrated that flyash and zeolite clays alone may improve the retention of most radionuclides and hazardous contaminants. Installing such a reactive permeable liner system under a mixed waste trench could provide a long-term solution to waste isolation as opposed to the uncertainty associated with long-term performance of landfill barriers, performance monitoring, and landfill liner systems. A permeable reactive barrier could be substantially lower in cost than a traditional double-lined system due to such factors as lower construction costs and elimination of the need to collect and treat leachate during the operating life cycle of the facility and could provide the ability to isolate waste for thousands of years.

D.5 Barrier Options

The Modified RCRA Subtitle C Barrier was selected for use in this EIS as the reference design barrier for LLW and MLLW disposal facilities and is discussed in Volume I, Section 2.2.3.6. A focused feasibility study (DOE-RL 1996) was performed to examine engineered barrier options that have broad application and are considered viable from the standpoint of effectiveness, implementability, and cost. The feasibility study evaluated a total of four conceptual barrier designs for different types of waste sites. The Hanford Barrier, the Modified RCRA Subtitle C Barrier, and the Modified RCRA Subtitle D Barrier were considered as the baseline designs for the purpose of the evaluation. A fourth barrier design, the

Standard RCRA Subtitle C Barrier, was also evaluated; it is commonly applied at other waste sites across the country. These four designs provide a range of barrier options to minimize health and environmental risks associated with a site and specific waste categories for design life periods of 1000, 500, 100, or 30 years, respectively. Design criteria for the 500- and 1000-year design life barriers include performance to extend beyond active institutional control and monitoring periods. An alternative approach, which is being considered for commercial radioactive waste disposal, is also discussed below.

D.5.1 Hanford Barrier

The Hanford Barrier was designed for disposal facilities with Greater than Category C (GTCC) LLW, GTCC MLLW, and/or wastes with significant inventories of TRU constituents. This barrier is designed to remain functional for a performance period of 1000 years and to provide the maximum practicable degree of containment and hydrologic protection of the evaluated designs. The Hanford Barrier is composed of nine layers of durable material (excluding the grading fill layer) with a combined thickness of 4.5 m (14.7 ft) (see Figure D.12). The barrier layers are designed to maximize evapotranspiration, and to minimize moisture infiltration and bio-intrusion, considering long-term variations in Hanford Site climate.

The primary structural differences between the Hanford Barrier and other barriers discussed in this report are increased thicknesses of the individual layers within the barrier and the inclusion of a coarse-fractured basalt layer to control bio-intrusion and to limit inadvertent human intrusion.

D.5.2 Standard RCRA Subtitle C Barrier

This barrier design can be used at disposal facilities containing hazardous constituents. This barrier is designed to provide containment and hydrologic protection for a minimum of 30 years, to include institutional control consisting of monitoring and necessary maintenance. The Standard RCRA Subtitle C Barrier is composed of five primary layers (not counting the grading fill layer) with a combined minimum thickness of 1.65 m (65 in.) (see Figure D.13). The barrier layers are designed to shed surface waters, and only minimally account for moisture retention and evapotranspiration capabilities. Bio-intrusion is mitigated primarily by institutional control, monitoring, and maintenance. However, EPA guidelines suggest using optional surface layer treatments for bio-intrusion considerations.

The Standard RCRA Subtitle C Barrier technology meets EPA's minimum technology guidance (EPA 1989). The Standard RCRA Subtitle C Barrier has limited applications and use at the Hanford Site. Limitations include a design life that may be inadequate for the radioactive waste categories; an anticipated high surveillance and maintenance and operations cost caused by implementation of the low permeability layer design features in an arid climate condition; and maintenance and operations cost caused by surface water runon and runoff control, collection, and discharge facilities.

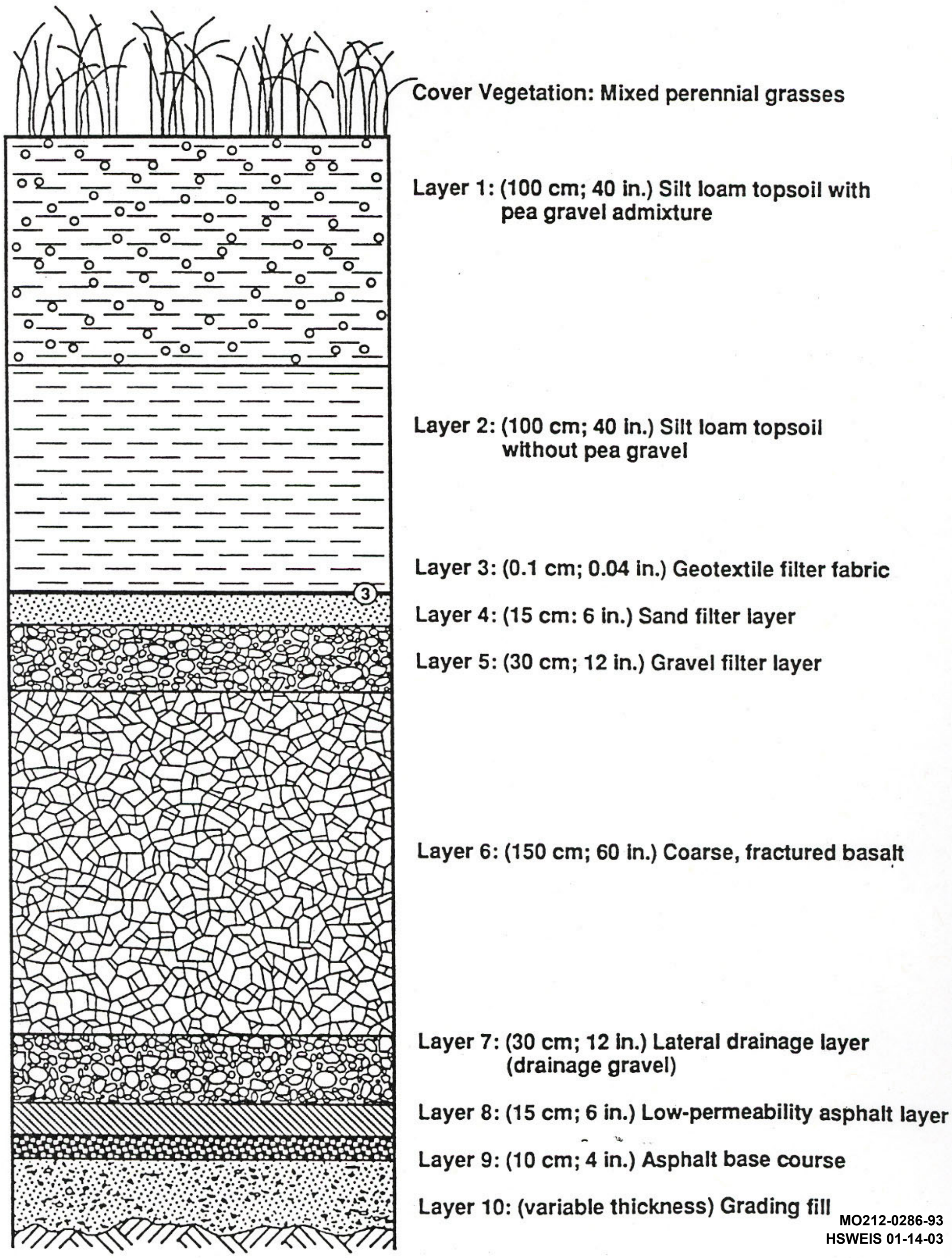

Figure D.12. Hanford Barrier

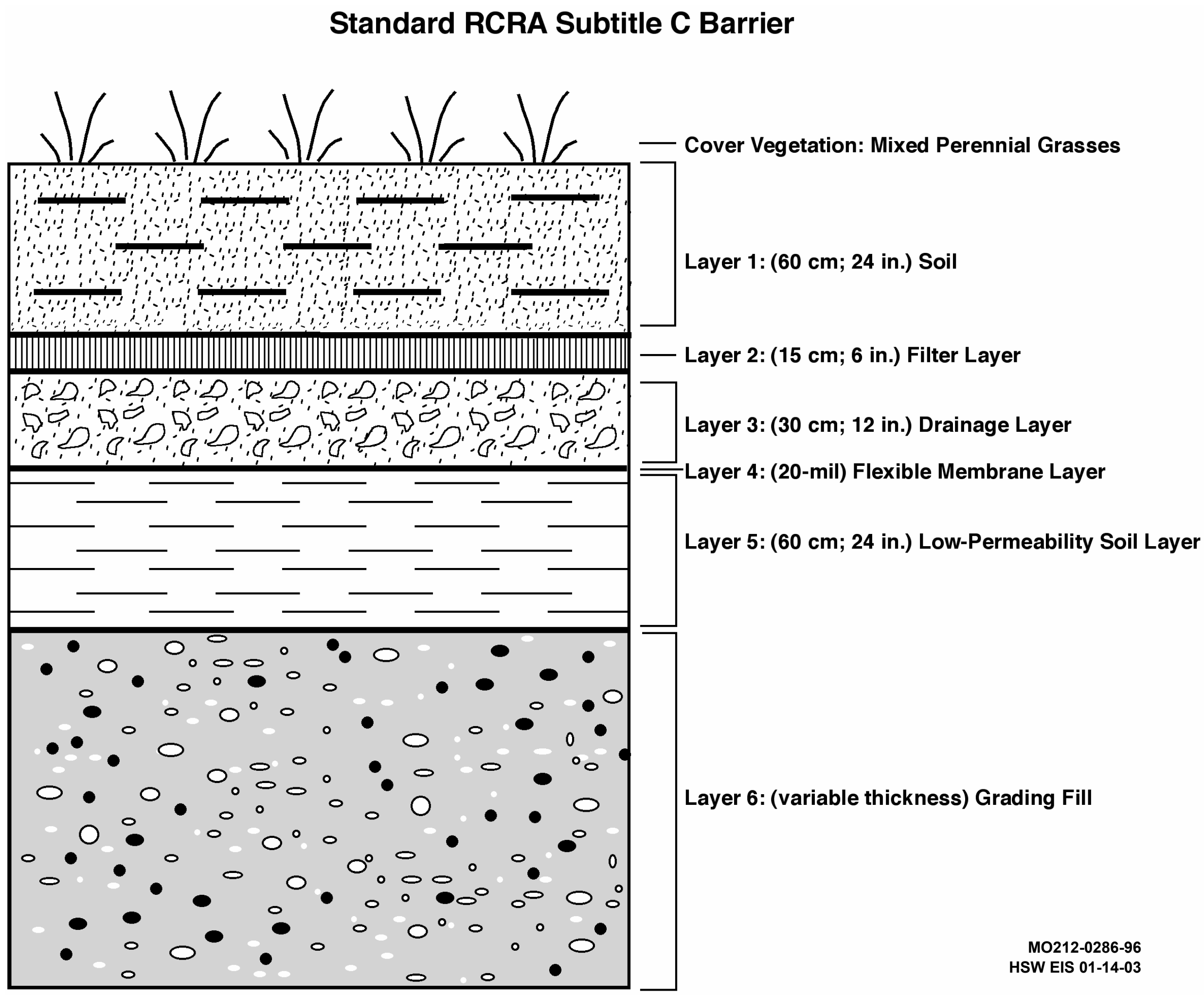

Figure D.13. Standard RCRA Subtitle C Barrier

D.5.3 Modified RCRA Subtitle D Barrier

This barrier is designed for non-radiological and non-hazardous solid waste disposal facilities, as well as Category 1 LLW sites where hazardous constituents are not present. The Modified RCRA Subtitle D Barrier as shown in Figure D.14 is composed of four layers of durable material with a combined minimum thickness of 0.90 m (2.9 ft) excluding the grading fill layer. It is designed to provide limited bio-intrusion and limited hydrologic protection (relative to the Hanford and Modified RCRA Subtitle C Barrier designs) for a performance period of 100 years. The performance period is consistent with the radionuclide concentrations and activity limits specified for Cat 1 LLW. The 100-year design life is also consistent with the minimum expected duration of active institutional control.

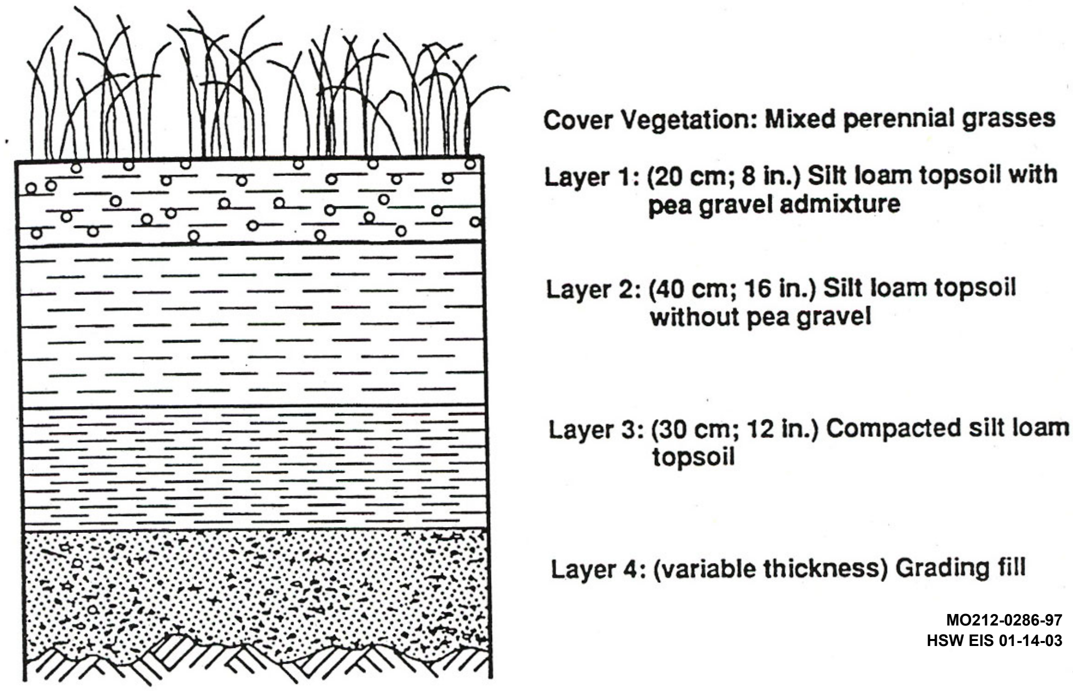

Figure D.14. Modified RCRA Subtitle D Barrier with Bentonite Mix

D.5.4 Conceptual Cover Barrier with Bentonite Mix

This barrier has been evaluated by WDOH (WDOH 1999) for use at the leased commercial disposal facility adjacent to the 200 Areas (the US Ecology, Inc. Site). The conceptual cover barrier is shown in Figure D.15. Some of the key characteristics of the barrier design are a 4-inch surface layer with 50 percent gravel, 36-inch silt loam layer, and a 12-inch bentonite clay (12 percent) low-permeability barrier.

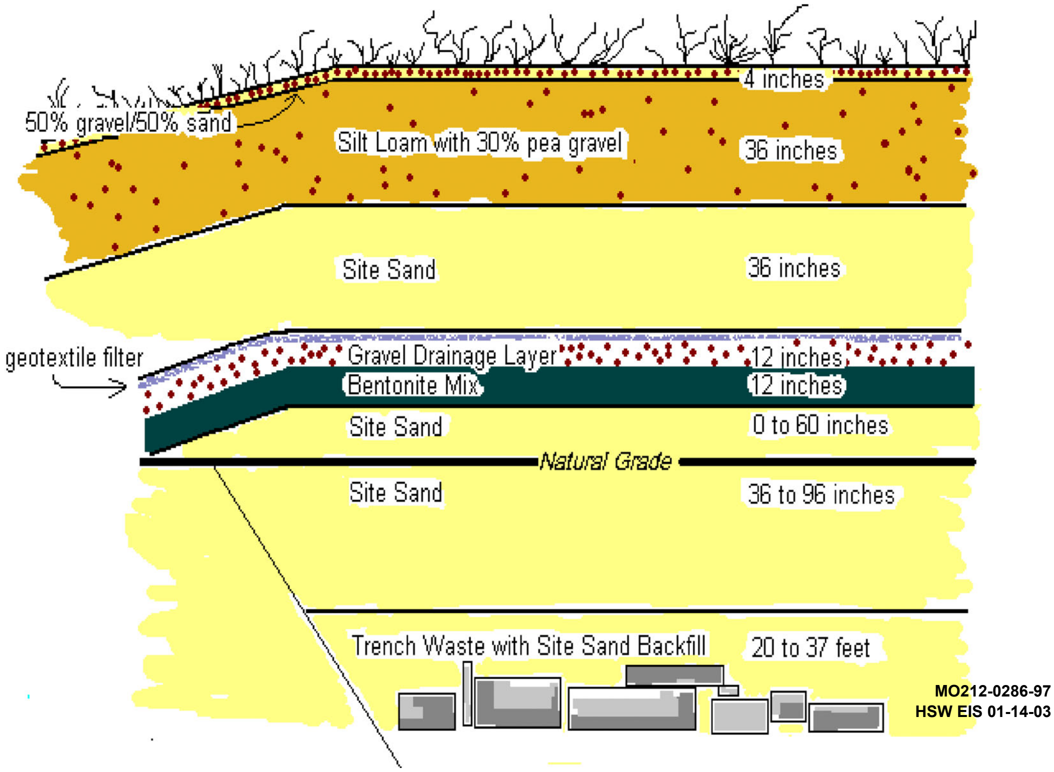

Figure D.15. US Ecology, Inc. Conceptual Cover Barrier

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